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B23K 37/00

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B3R RSS R141

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GB 2189177 A GB 2074070 A

(58) Field of search

UK CL (Edition K) B3R, B3V

INT CL<sup>5</sup> B23K

(54) A method of seam welding

(57) A method for welding fan blades (5) to a secondary disc (4) both of sheet aluminium of a fan (1) by two spaced apart seam welds of predetermined length and at predetermined locations along a joint (10) comprises mounting the secondary disc (4) and a main disc (3) with the fan blades (5) already secured thereto in a jig (2). A templet (60) of copper material comprises a pair of guide slots (63) and (64) for locating the seam welds (11) and (12). The templet (60) is secured with an elongated side edge (62) extending along the joint (10) and an outer side edge (70) aligned with an outer edge (16) of the fan blade (5). The joint (10) is welded through the guide slots (63) and (64) to form the seam welds (11) and (12).

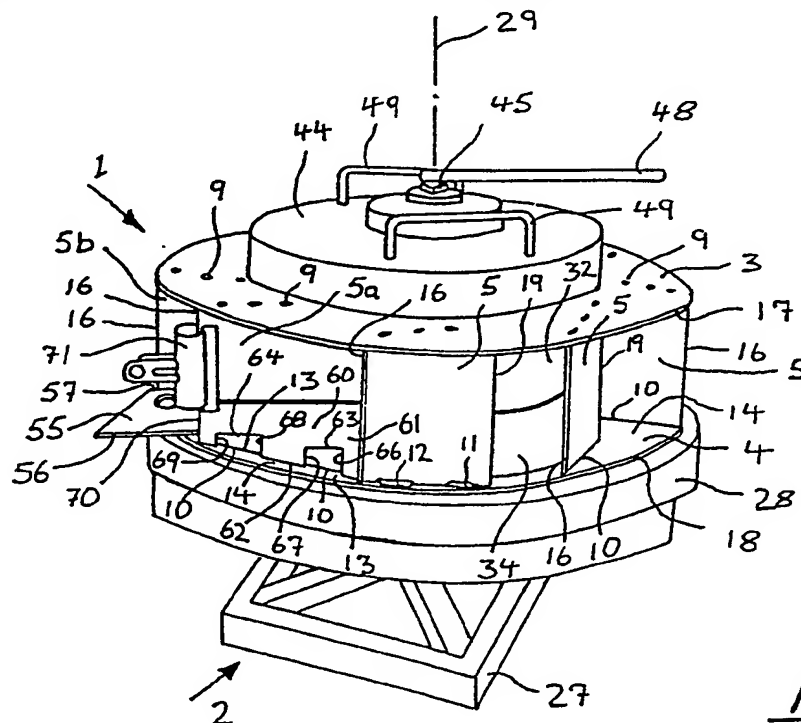
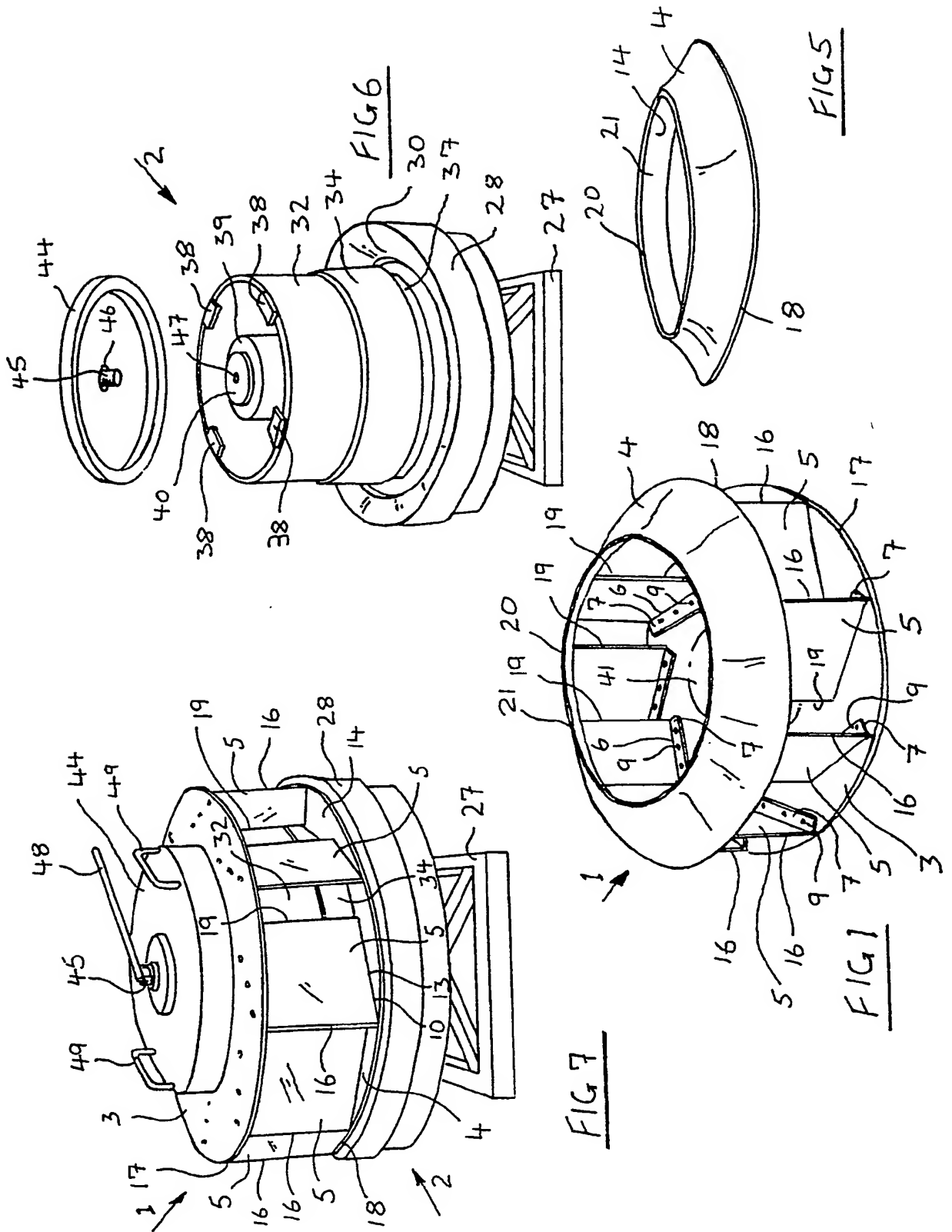


FIG 9

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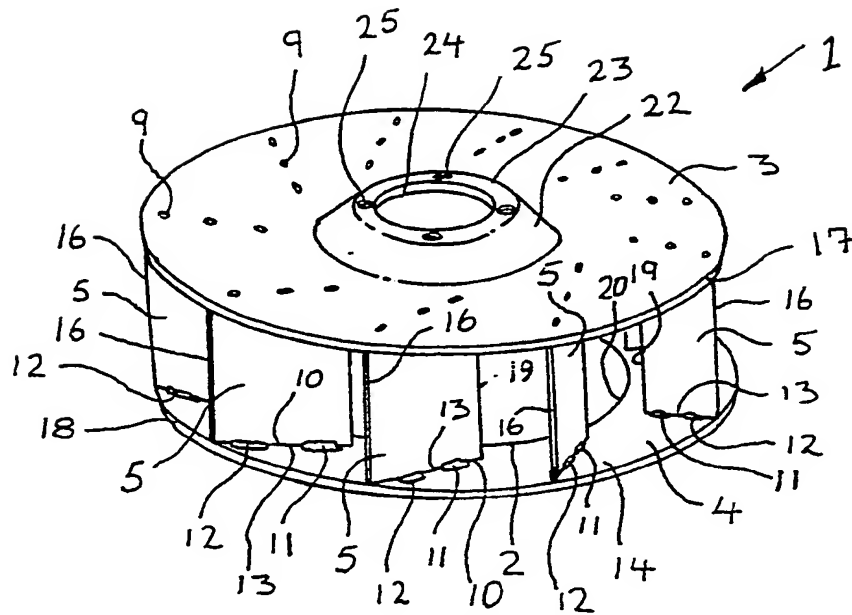


FIG 2

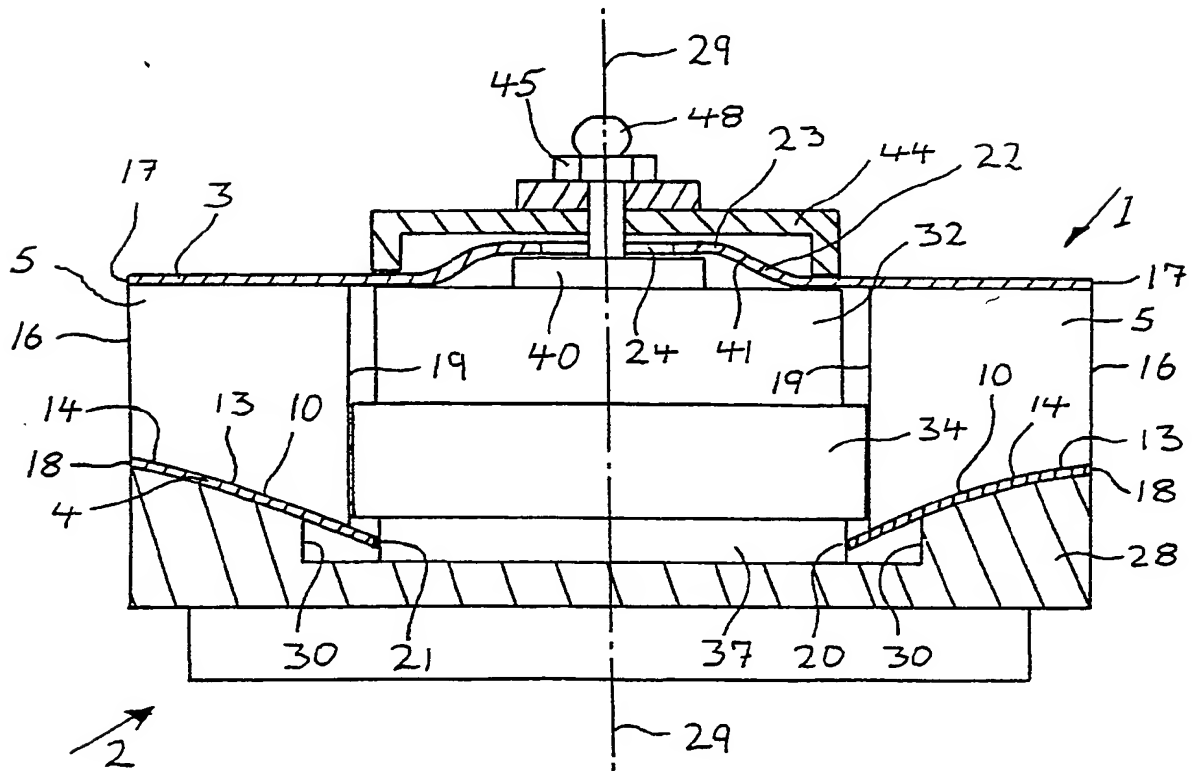


FIG 10

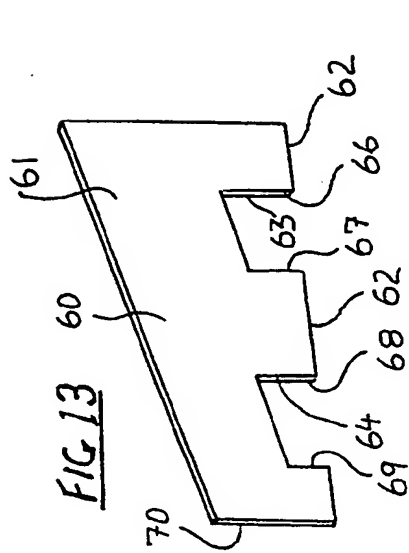


FIG 13

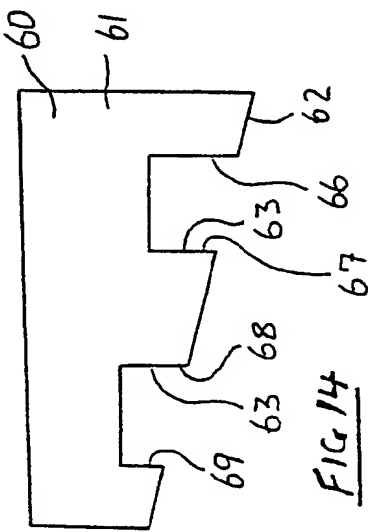


FIG 14

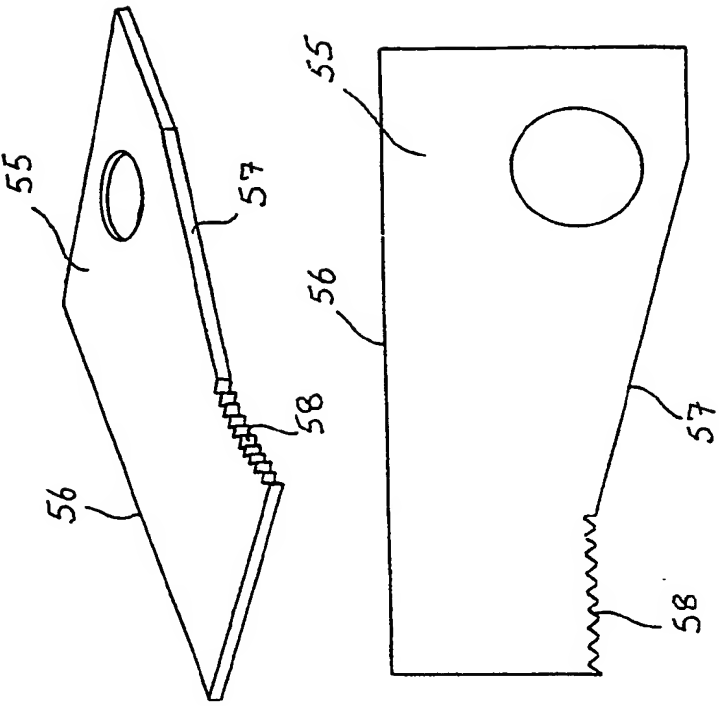


FIG 11

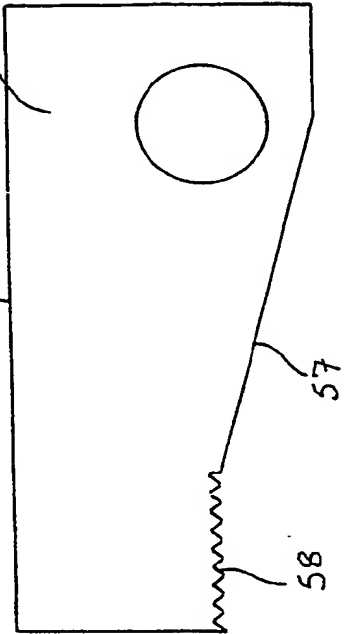


FIG 12

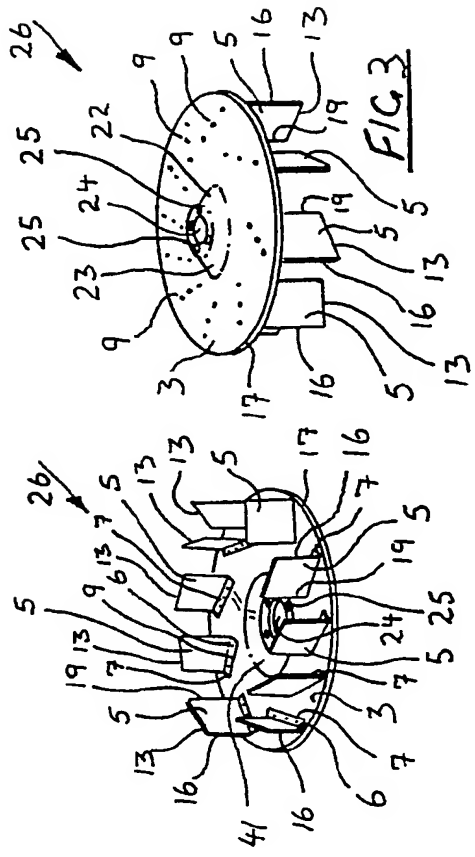


FIG 3

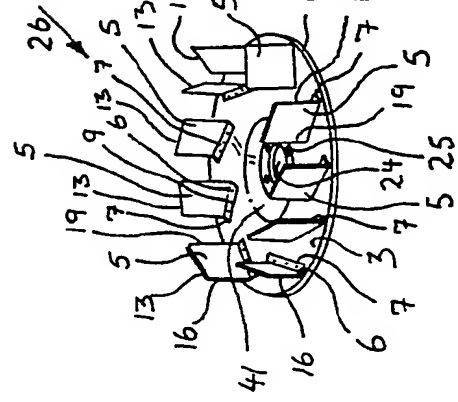


FIG 4

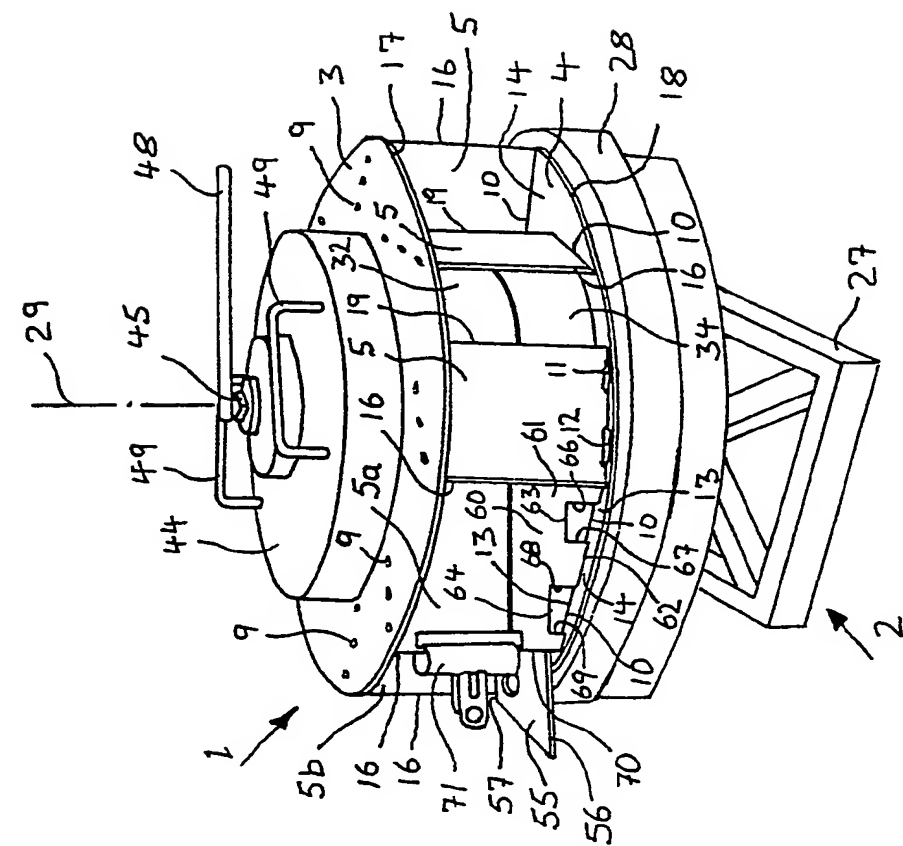


FIG 9

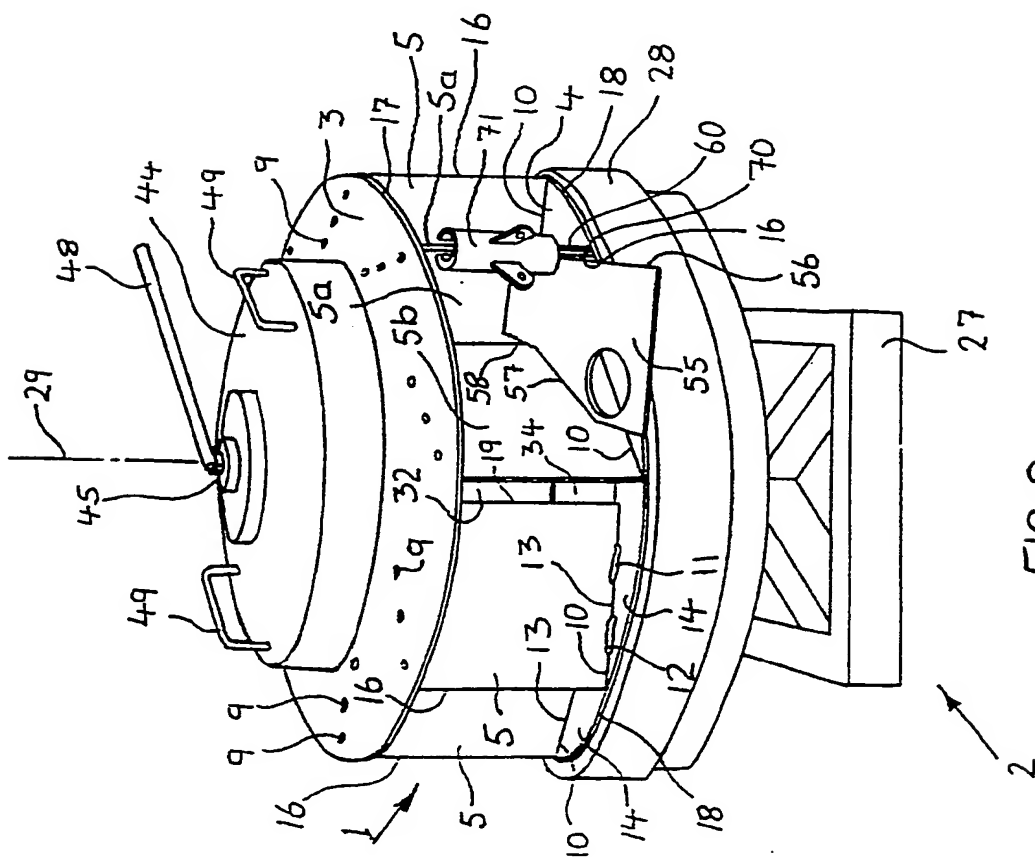


FIG 8

A METHOD FOR SEAM WELDING

The present invention relates to a method for welding a pair of members together by a seam weld extending for a predetermined length at a predetermined location along an elongated joint between the members, and in particular, the method relates to a method for welding a pair of aluminium plate members together, for example a fan blade to a radially extending, annular disc. The method also relates to a jig for carrying out the method and to a fan manufactured according to the method.

Fans having a main mounting disc and an annular secondary disc and a plurality of fan blades mounted to, and extending between the two discs are known. In particular, such fans are known for use in air conditioning systems. Such fans, in general, are referred to as axial/radial flow fans, due to the fact that air, in general, is drawn axially into the fan through the annular disc and delivered from the fan between the blades in a generally radial direction. In the manufacture of these fans, it is essential that the fan blades should be secured to the main mounting disc and the secondary disc in such a way as to minimise any imbalance in the fan to avoid out of balance forces being generated on rotation of the fan. Generally, the fan blades are secured to the main mounting disc by rivets and are secured to the secondary disc by seam

welds. In general, to keep the weight of the fan to a minimum, the seam welds do not extend the length of the joint between the fan blade and the secondary disc. In general, two seam welds at spaced apart locations along the joint are provided. However, it is essential that corresponding seam welds on the blades should be of substantially identical length and should be located in substantially identical positions relative to the fan blades and the secondary disc. Otherwise, an imbalance will be induced in the fan leading to out of balance forces being generated on rotation of the fan.

So far, no satisfactory method of maintaining the length and locations of the seam welds substantially constant from fan blade to fan blade is known.

There is therefore a need for a method for welding fan blades to a secondary disc which overcomes these problems. Indeed, there is a need for a method which permits any two members to be welded by a seam weld of predetermined length and at a predetermined location along a joint between the members. There is also a need for a jig for carrying out the method.

The present invention is directed towards providing such a method and a jig for carrying out the method, as well as a fan manufactured according to the method.

According to the invention, there is provided a method for welding a pair of members together by a seam weld extending for a predetermined length at a predetermined location along an elongated joint between the members, the method comprising the steps of locating one member in the desired orientation relative to the other member to form the joint, placing a templet along the joint, the templet being of a material non-weldable to the members, and having at least one guide opening therein, corresponding to the length and location of the seam weld, forming the seam weld by welding the members together at the joint through the guide opening in the templet.

Preferably, the method comprises welding the members by at least two seam welds spaced apart longitudinally along the joint, the templet comprising at least two guide openings corresponding to the respective lengths and locations of the seam welds. Advantageously, the members are sheet members, and preferably, the sheet members are sheet metal members.

In one embodiment of the invention, the templet comprises a plate member having an elongated side edge, each guide opening being formed by a slot extending into the plate member from the elongated side edge.



Advantageously, the members are joined at right angles to each other along the joint, the templet being placed against and parallel to one of said members, and the elongated edge of the templet engaging the other of  
5 said members adjacent the joint.

In one embodiment of the invention, the method is for welding fan blades to a radially extending, annular, secondary disc of a fan, one of the members being a fan blade and the other member being the secondary disc,  
10 the fan comprising a radially extending main mounting disc, and the fan blades being secured to and extending between the main mounting disc and the secondary disc.

Additionally, the invention provides a templet for carrying out the method according to the invention, the  
15 templet comprising a plate member having at least one opening therethrough, the opening corresponding to the length and location of the seam weld.

Advantageously, the plate member of the templet defines an elongated side edge, the opening being formed by a  
20 slot extending into the plate member from the side edge. Preferably, at least two slots are provided extending into the plate member from the elongated side edge at spaced apart locations therealong.

Further, the invention provides a jig for welding fan blades of a fan to a radially extending, annular, secondary disc, wherein the fan comprises a main mounting disc and the fan blades extending between the main mounting disc and the secondary disc, the jig comprising receiving means for receiving and locating the secondary disc, and central support means co-axial with the receiving means for positioning the main mounting disc having the fan blades secured thereto relative to the secondary disc.

Additionally, the invention provides a fan manufactured according to the method of the invention.

Further, the invention provides a fan manufactured on the jig according to the invention.

15 Additionally, the invention provides a fan manufactured according to the method of the invention, using the templet also according to the invention.

The invention will be more clearly understood from the following description of a preferred embodiment thereof, given by way of example only, with reference to the accompanying drawings, in which:

Fig. 1 is a perspective view of a fan according to the invention,

Fig. 2 is a perspective view of the fan of Fig. 1 from a different direction,

5      Fig. 3 is a perspective view of portion of the fan of Fig. 1,

Fig. 4 is a perspective view of the portion of the fan of Fig. 3 from a different direction,

10      Fig. 5 is a perspective view of another portion of the fan of Fig. 1,

Fig. 6 is a perspective view of a jig according to the invention for use in a method for manufacturing the fan of Fig. 1,

15      Fig. 7 is a perspective view of the jig of Fig. 6 in use,

Fig. 8 is a perspective view of the jig of Fig. 6 also in use,

Fig. 9 is a perspective view of the jig of Fig. 6 also in use,

Fig. 10 is a cross sectional elevational view of the jig of Fig. 6 in use,

Fig. 11 is a perspective view of a locating plate for use with the method of the invention,

5 Fig. 12 is a plan view of the locating plate of Fig. 11,

Fig. 13 is a perspective view of a templet also according to the invention for use with the method of the invention, and

10 Fig. 14 is a plan view of the templet of Fig. 13.

Referring to the drawings, and initially to Figs. 1 to 5, there is illustrated a fan according to the invention indicated generally by the reference numeral 1 which is manufactured on a jig indicated generally by the reference 2 illustrated in Figs. 6 to 10 using a method also according to the invention which is described below. However, before describing the method of the invention for manufacturing the fan 1, the fan 1 will first be described in detail.

20 The fan 1 comprises a main mounting disc 3 of aluminium

sheet material of 5 mm thickness which extends in a generally radial direction and an annular secondary disc 4 of aluminium sheet material of 2.5 mm thickness which also extends in a generally radial direction. A plurality of fan blades 5 also of aluminium sheet material of 2 mm thickness extend between the main mounting disc 3 and a secondary disc 4. Each fan blade 5 is bent at 6 to form a mounting flange 7. Rivets 9 through the main mounting disc 3 and the mounting flange 7 secure the fan blades 5 to the main mounting disc 3.

The fan blades 5 are secured to the secondary disc 4 along a joint 10 by two seam welds, namely, an inner seam weld 11 and an outer seam weld 12 which are longitudinally spaced apart along the joint 10. The joints 10 are formed between edges 13 of the fan blades 5 and a surface 14 of the secondary disc 4. The seam welds 11 and 12 are provided at predetermined locations and are of predetermined length. In this case, the seam welds 11 and 12 are of equal length. However, it will be readily appreciated by those skilled in the art that the seam welds 11 and 12 may be of a different length. All the inner seam welds 11 of the joints 10 are of identical length and are located at identical radial locations. Similarly, the outer seam welds 12 of the joints 10 are of identical length and are

located at identical radial locations.

Each fan blade 5 has an outer edge 16 which co-incides with outer edges 17 and 18 of the main mounting disc 3 and secondary disc 4, respectively. An inner edge 19 of the fan blades 5 defines a circle of radius less than the inner radius of an inner rim 20 of the secondary disc 4, see Fig. 10. Although, the secondary disc 4 extends outwardly in a generally radial direction, the inner rim 20 extends in a generally axial direction and defines an axial air inlet 21 to the fan. On rotation of the fan 1 about its central axis, air is drawn axially into the fan through the axial inlet 21 and delivered radially outwardly in a radial direction relative to the fan 1 by the fan blades 5. Such fans 1 will be known to those skilled in the art, and in general, are referred to as axial/radial flow fans.

The central portion of the main mounting disc 3 is shaped at 22 to form a boss 23. A central hole 24 through the boss 23 accommodates a shaft (not shown) onto which the fan 1 is mounted. Holes 25 in the boss 23 accommodate screws (not shown) for securing the fan 1 on the shaft (also not shown).

In the manufacture of the fan 1, the fan blades 5 are

secured to the main mounting disc 3 by the rivets 9 through the mounting flange 7 to form a sub-assembly 26, see Figs. 3 and 4. The fan blades 5 prior to being riveted to the main mounting disc 3 are aligned with the main mounting disc 3 using a suitable jig. Such jigs will be known to those skilled in the art, and it is not intended to describe the jig in further detail. On the sub-assembly 26 being formed, the secondary disc 4 is then welded to the fan blades 5 in the jig 2 illustrated in Figs. 6 to 9, which will now be described.

Referring now to Figs. 6 to 10, the jig 2 comprises a main framework 27 and a base 28 rotatably mounted to the main framework 27 about a vertical axis 29. A stub shaft (not shown) extending upwardly from the main framework 27 rotatably carries the base 28. Receiving means comprising an annular locating groove 30 formed in the base 28 receives and locates the secondary disc 4 as will be described below. The locating groove 30 is co-axial with the vertical axis 29. A central support means comprising a hollow central column 32 extends upwardly from the base 28 co-axial with the rotational axis 29 for locating the sub-assembly 26 of the main mounting disc 3 and the fan blades 5. The central column 32 is within the locating groove 30. The central column 32 is of stepped diameter having a

blade engaging portion 34 for engaging the inner edges  
19 of the fan blades 5 for positioning the sub-assembly  
26 relative to the secondary disc 4. The diameter of  
the column 32 is undercut at 37 to accommodate the  
5 inner rim 20 of the secondary disc 4 in the locating  
groove 30. Mounting lips 38 extend inwardly from the  
central column 32 for abutting the main mounting disc 3  
of the sub-assembly 26. A core member 39 extends  
upwardly through the column 32 and carries a boss 40  
10 co-axial with the rotational axis 29 for engaging a  
recess 41 in the main mounting disc 3 formed by the  
boss 23. The main mounting disc 3 of the sub-assembly  
26 is secured to the central column 32 by securing  
means, namely, a clamping plate 44 which clamps the  
15 main mounting disc 3 to the central column 32. A screw  
45 through a hole 46 in the clamping plate 44 engages a  
threaded bore 47 through the core member 39 for  
releasably retaining the clamping plate 44 in  
engagement with the main mounting disc 3. A handle 48  
20 extending from the screw 45 facilitates tightening of  
the screw 45. A pair of hand grips 49 on the mounting  
plate 44 facilitate placing of the clamping plate 44 in  
position.

To position the secondary disc 4 and the sub-assembly  
25 26 on the jig 2 for welding of the fan blades 5 to the  
secondary disc 4, the secondary disc 4 is placed on the



base 28 with the inner rim 20 extending into the locating groove 30 and abutting the undercut portion 37 of the central column 32, see Fig. 10. The sub-assembly 26 is then placed over the central column 32 with the inner edges 19 of the fan blades 5 engaging the blade engaging portion 34 and with the edges 13 of the fan blades 5 abutting the surface 14 of the secondary disc 4 to form the joints 10. The clamping plate 44 is then secured to the core member 39 by the screw 45.

In the method according to the invention for welding the fan blades 5 to the secondary disc 4, the outer edge 16 of a fan blade 5a to be welded is aligned with the outer edge 18 of the secondary disc 4, see Fig. 10.

The fan blades 5 are shaped and mounted to the main mounting disc 3 so that on the outer edge 16 of a fan blade 5 being aligned with the outer edge 18 of the secondary disc 4, the fan blade 5 extends from the surface 14 of the secondary disc 4 at right angles.

A locating means comprising a locating plate of steel illustrated in Figs. 11 and 12 and indicated by the reference numeral 55 is inserted between a pair of adjacent fan blades 5a and 5b as illustrated in Fig. 8 for urging one of the fan blades 5a into position with its outer edge 16 aligned with the outer edge 18 of the

secondary disc 4. The locating plate 55 comprises opposite side edges 56 and 57 for engaging the fan blades 5a and 5b respectively. A retaining means comprising a serrated edge 58 for engaging the inner edge 19 of the fan blade 5b, see Fig. 8, retains the locating plate 55 in position between the fan blades 5a and 5b with the outer edge 18 of the fan blade 5a aligned with the secondary disc 4.

A templet according to the invention illustrated in Figs. 13 and 14 and indicated by the reference numeral 60 is provided for locating and determining the lengths of the inner and outer seam welds 11 and 12. The templet 60 is of copper plate material which is non-weldable to the fan blades 5 and the secondary disc 4. In other words, the templet 60 being of copper does not weld to the aluminium material of the fan blades 5 and secondary disc 4. The templet 60 comprises an elongated side edge 62 which in use extends along the joint 10. Guide openings, namely, two guide slots 63 and 64 extend from the side edge 62 into the plate 61 which expose the portions of the joint 10 along which the seam welds 11 and 12 are to be formed. The guide slots 63 and 64 determine the respective lengths and locations of the seam welds 11 and 12, respectively. In other words, the distance from the edge 66 to the edge 67 of the guide slot 63 along the side edge 62

determines the length of the inner seam weld 11. The distance from the edge 68 to the edge 69 of the guide slot 64 along the side edge 62 determines the length of the outer seam weld 12.

5 In carrying out the method of the invention, the templet 60 is placed parallel to and engaged against the fan blade 5a on the side of the fan blade 5a on which the seam welds 11 and 12 are to be formed. The side edge 62 of the templet 60 is provided extending  
10 along the joint 10. A side edge 70 of the templet 60 is aligned with the outer edge 16 of the fan blade 5a, see Figs. 8 and 9. The templet 60 is secured in this position to the fan blade 5a by any suitable clip means. In this case, a crocodile clip 71 is used. The  
15 fan blade 5a is now ready for welding to the secondary disc 4. A tungsten inert gas welding process is used. Where a gap exists at the joint 10 between the edge 13 of the fan blade 5a and the surface 14, a welding rod is used. Otherwise, a welding rod is not required, and  
20 the materials of the fan blade 5a and the secondary disc 4 are fused together at the joint 10 using the tungsten inert gas welding process. The welding rod or head of the tungsten inert gas welder, as the case may be, is aligned with the portion of the joint 10 exposed  
25 by the guide slot 63 between the edges 66 and 67 of the slot 63, and the said portion of the joint 10 is welded

through the guide slot 63 to form the seam weld 11.  
The head of the tungsten inert gas welding apparatus or  
the welding rod as the case may be is then aligned with  
the portion of the joint 10 exposed by the guide slot  
5 64 between the edges 68 and 69, and the said portion of  
the joint 10 is welded, thus forming the seam weld 12.  
By virtue of the fact that the templet is of copper and  
non-weldable to the aluminium material of the fan blade  
5a and the secondary disc 4, the seam welds 11 and 12  
10 respectively terminate at the edges 66 and 67, and 68  
and 69 of the guide slots 63 and 64, respectively,  
thereby ensuring seam welds 11 and 12 of relatively  
accurate length and relatively accurately located.

On the seam welds 11 and 12 of the fan blade 5a having  
15 been completed, the next fan blade 5 to be welded is  
selected. To avoid buckling of the secondary disc 4  
and the fan blades 5, a fan blade on the opposite side  
of the fan 1 is selected next for welding. In this  
embodiment of the invention, the fan comprises ten fan  
20 blades 5 and the welding sequence is as follows: blade  
numbers 1, 7, 3, 10, 5, 2, 8, 4, 9 and 6, where the  
blades are numbered sequentially from 1 to 10 in a  
clockwise direction.

On all the fan blades 5 being welded to the secondary  
25 disc 4, the clamping plate 44 is released by releasing

the screw 45 and the fan 1 is removed from the jig 2 and is ready for use.

The advantages of the invention are many. A particular advantage of the invention is that the length and  
5 location of the seam welds 11 and 12 are precisely determined. Provided the side edge 70 of the templet 60 is accurately aligned with the outer edge 16 of the fan blade 5 being welded, the location of the seam welds 11 and 12 is precisely determined.

10 A further advantage of using the templet 60 according to the invention is that the templet 60, being of plate copper material, acts as a heat sink from the fan blade 5 being welded. Since the fan blades 5 are of a lighter gauge material than the secondary disc 4, it is  
15 important that heat be conducted away from the fan blades 5 at a greater rate than from the secondary disc 4 to avoid overheating, and the possible burning of the edges 13 of the fan blades 5. The templet 60, as well as accurately determining the length and the location  
20 of the seam welds 11 and 12, also acts to conduct heat relatively rapidly away from the edge 13 of the fan blades 5 in the area of the seam welds during welding to avoid any danger of the edges 13 of the fan blades 5 burning.

While a specific shape and construction of jig has been described, any other suitable shape and construction of jig may be used, and indeed, in certain cases, the jig 2 may be dispensed with. Indeed, it is not necessary, 5 although it is preferable, for the base 28 to be rotatably mounted on the framework 27. Needless to say, where a jig is provided, any other suitable central support means may be provided, as indeed, may any other suitable securing means for securing the main 10 mounting disc 3 to the jig. Needless to say, any other receiving means besides a locating groove formed in the base member for receiving the secondary disc may also be provided.

It will of course be appreciated that while the fan 15 blades are only welded to the secondary disc 4, the fan blades may be welded to the main mounting disc 3 instead of being riveted thereto. Indeed, any other suitable securing means may be used for securing the fan blades 5 to the main mounting disc 3. Needless to 20 say, if desired, the fan blades 5 may be welded to the main mounting disc 3 and secured by other suitable means to the secondary disc 4.

While the method has been described for use in welding fan blades 5 to a secondary disc 4 of a fan, the method 25 may be used for welding any plate members together.

Indeed, the method may be used for welding any members together. Needless to say, the method may be used for welding members or plate members of other materials besides aluminium material together. Where the members  
5 to be welded together are of materials other than aluminium, the templet will be of a suitable material which is non-weldable to the material of the members to be welded together.

While the fan blades have been described as being  
10 welded to the secondary disc 4 by tungsten inert gas welding, any other suitable welding process may be used.

It will of course be appreciated that while the fan has been described as being of a particular shape and  
15 construction and has been described as comprising ten blades, the method may be used in the manufacture of any other shapes and construction of fans, and indeed, it is not necessary that the fan be an axial/radial flow fan.

20 It will of course be appreciated that while it is preferable it is not essential to use a locating means for aligning the outer edges of the fan blades 5 with the secondary disc 4.

CLAIMS

1. A method for welding a pair of members together by a seam weld extending for a predetermined length at a predetermined location along an elongated joint between the members, the method comprising the steps of  
5 locating one member in the desired orientation relative to the other member to form the joint, placing a templet along the joint, the templet being of a material non-weldable to the members, and having at  
10 least one guide opening therein, corresponding to the length and location of the seam weld, forming the seam weld by welding the members together at the joint through the guide opening in the templet.
2. A method as claimed in Claim 1 in which the method  
15 comprises welding the members by at least two seam welds spaced apart longitudinally along the joint, the templet comprising at least two guide openings corresponding to the respective lengths and locations of the seam welds.
- 20 3. A method as claimed in Claim 1 or 2 in which the members are sheet members.
4. A method as claimed in Claim 3 in which the sheet members are sheet metal members.



5. A method as claimed in any preceding claim in which the templet comprises a plate member having an elongated side edge, each guide opening being formed by a slot extending into the plate member from the  
5 elongated side edge.

6. A method as claimed in Claim 5 in which the members are joined at right angles to each other along the joint, the templet being placed against and parallel to one of said members, and the elongated edge of the  
10 templet engaging the other of said members adjacent the joint.

7. A method as claimed in Claim 5 or 6 in which the method is for welding fan blades to a radially extending, annular, secondary disc of a fan, one of the  
15 members being a fan blade and the other member being the secondary disc, the fan comprising a radially extending main mounting disc, and the fan blades being secured to and extending between the main mounting disc and the secondary disc.

20 8. A method as claimed in Claim 7 in which the fan blades are welded to the secondary disc along respective elongated joints extending across the secondary disc from a position adjacent an inner edge to a position adjacent an outer edge of the secondary

disc.

9. A method as claimed in Claim 7 or 8 in which the method further comprises the step of securing the fan blades to the main mounting disc by rivets.

5 10. A method as claimed in any of Claims 7 to 9 in which a fan blade to be welded is located relative to the secondary disc by placing a locating means between the said fan blade to be welded and its next adjacent fan blade, the locating means engaging both fan blades.

10 11. A method as claimed in Claim 10 in which the locating means comprises a locating plate having a pair of opposite side edges for respectively engaging the fan blade to be welded and its next adjacent fan blade, and retaining means for engaging one or other of the  
15 fan blades for retaining the locating means in position between the fan blades.

12. A method as claimed in Claim 11 in which the retaining means comprises a serrated portion along one of the side edges of the locating plate.

20 13. A method as claimed in any of Claims 7 to 12 in which the secondary disc and the main mounting disc with the fan blades secured thereto are placed in a jig

for positioning the fan blades relative to the secondary plate.

14. A method as claimed in any preceding claim in which the members to be welded are of aluminium  
5 material.

15. A method as claimed in any preceding claim in which the templet is of copper material.

16. A method for welding a pair of members together by a seam weld extending for a predetermined length at a  
10 predetermined location along an elongated joint between the members, the method being substantially as described herein with reference to and as illustrated in the accompanying drawings.

17. A templet for carrying out the method of any of  
15 Claims 1 to 16 in which the templet comprises a plate member having at least one opening therethrough, the opening corresponding to the length and location of the seam weld.

18. A templet as claimed in Claim 17 in which the  
20 plate member of the templet defines an elongated side edge, the opening being formed by a slot extending into the plate member from the side edge.

19. A templet as claimed in Claim 18 in which at least two slots are provided extending into the plate member from the elongated side edge at spaced apart locations therealong.

5 20. A templet substantially as described herein with reference to and as illustrated in the accompanying drawings.

21. A jig for welding fan blades of a fan to a radially extending, annular, secondary disc, wherein  
10 the fan comprises a main mounting disc and the fan blades extending between the main mounting disc and the secondary disc, the jig comprising receiving means for receiving and locating the secondary disc, and central support means co-axial with the receiving means for  
15 positioning the main mounting disc having the fan blades secured thereto relative to the secondary disc.

22. A jig as claimed in Claim 21 in which the jig comprises a base member rotatable about a central rotational axis, the receiving means being formed by an  
20 annular locating groove formed therein, the central support means comprising a central column extending upwardly from the base member internally of and co-axial with the locating groove, and securing means for

securing the main mounting disc to the central column.

23. A jig as claimed in Claim 22 in which the securing means comprises a clamping plate releasably securable to the central column for clamping the main mounting  
5 disc between the clamping plate and the central column.

24. A jig as claimed in any of Claims 21 to 23 further comprising a locating means engagable between a pair of fan blades for locating one of the fan blades relative to the secondary disc.

10 25. A jig substantially as described herein with reference to and as illustrated in the accompanying drawings.

26. A fan manufactured according to the method of any of Claims 1 to 16.

15 27. A fan manufactured on the jig according to any of Claims 21 to 25.

28. A fan manufactured according to the method of any of Claims 1 to 16 using the templet of any of Claims 17 to 20.

20 29. A fan produced according to the method of any of

Claims 1 to 16 using the jig of any of Claims 21 to 25  
and the templet of any of Claims 17 to 20.

30. A fan substantially as described herein with  
reference to and as illustrated in the accompanying  
5 drawings.

**Patents Act 1977**  
**Examiner's report to the Comptroller under**  
**Section 17 (The Search Report)**

Application number  
9123834.5

**Relevant Technical fields**

(i) UK CI (Edition K ) B3R, B3V

(ii) Int CI (Edition 5 ) B23K

**Databases (see over)**

(i) UK Patent Office

(ii)

**Search Examiner**

D N P BUTTERS

**Date of Search**

31.01.1992

Documents considered relevant following a search in respect of claims 1-20, 28, 30

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
X	GB 2189177 (WILLIAM HENDERSON)	1, 2, 17
X	GB 2074070 (GILLETTE)	1-4, 17

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